Target Cooldown Update

Polarized Target Meeting

12/06/18

Cool-down Priorities

- Fridge and valve tests
- Microwave calibration and automation tests
- NMR Studies
- Warm NMR to PDP NMR Ratio test
- Cold NMR test
- Cernox Sensor calibration
- Fridge magnetic field map
- Magnet PS tests and controls tests
- Vacuum/Turbo tests

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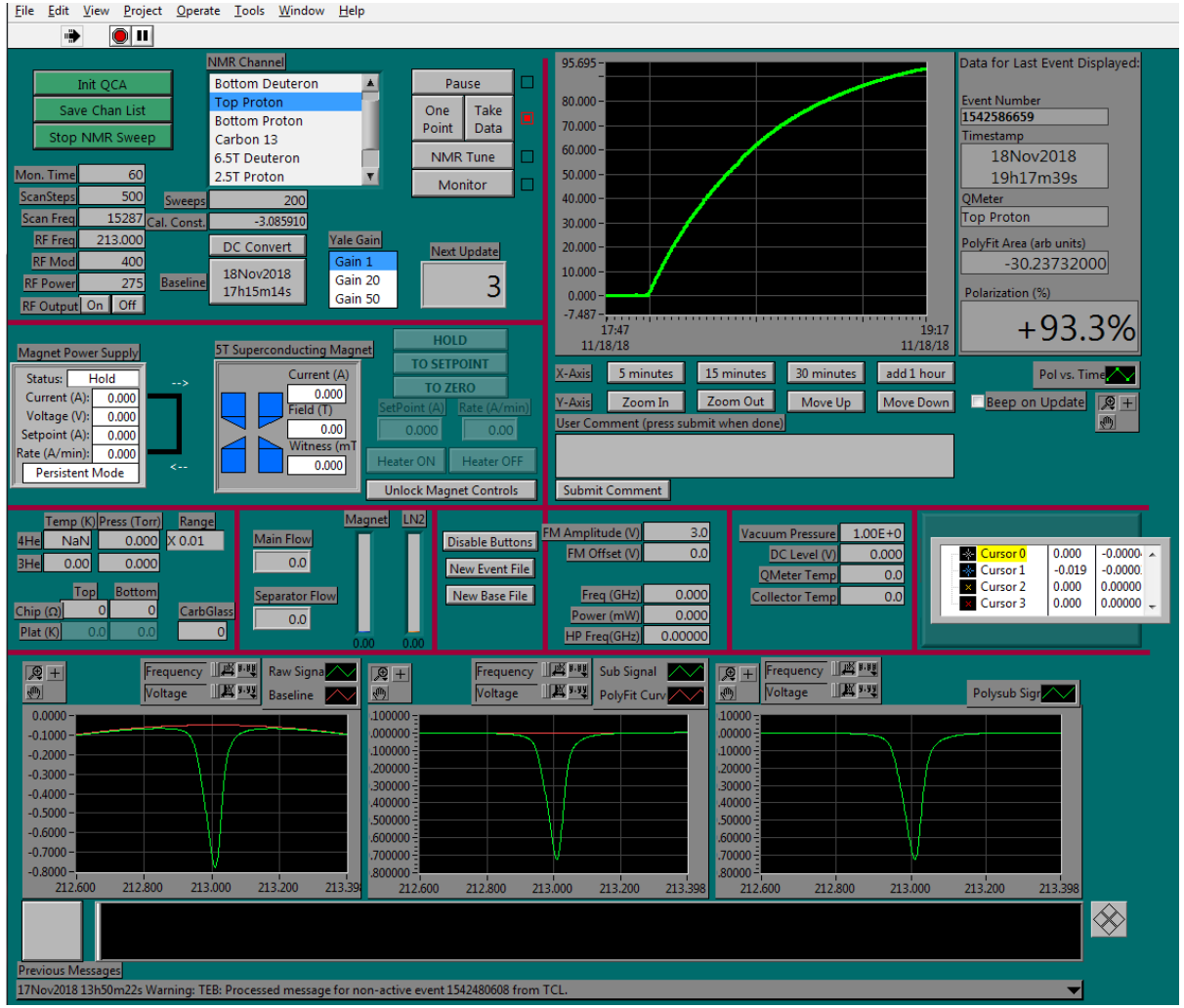
Overview

- Valve tests show that controls and automation are working properly.
- Target works and polarized around 98%
- Microwave controls improvements look good and there is a plan to make them better.
- NMR comparisons look promising. We got lots of data, comparisons look promising, no signs of polarization degradation, but still need a lot of analysis.
- Magnet controls worked.
- Achieved 1.5e-7 torr using turbo pump.

- Separator flow control (Teladyne/Hasting) deemed a success
  - Both Separator Flow and Main Flow with unit.
  - Separator flow control occasionally oscillated at low flow rate but it was acceptable.
  - The main flow test went good but readout was a little glitchy on one channel.



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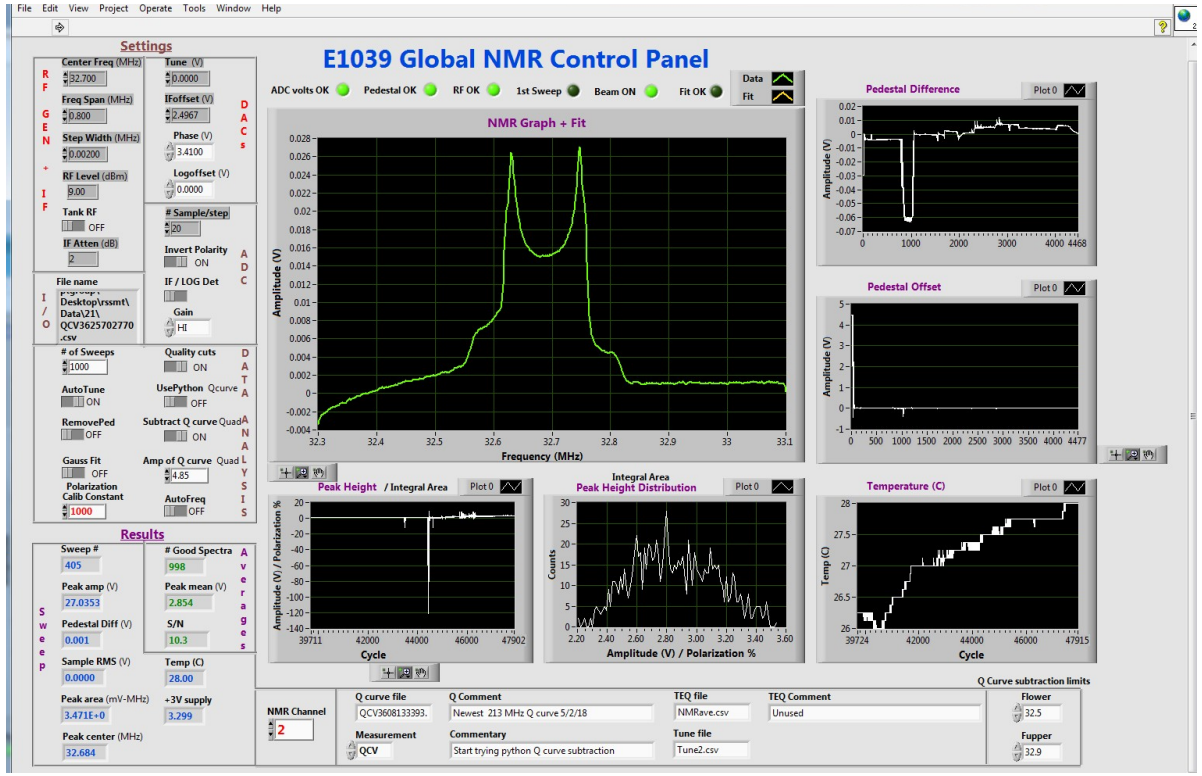

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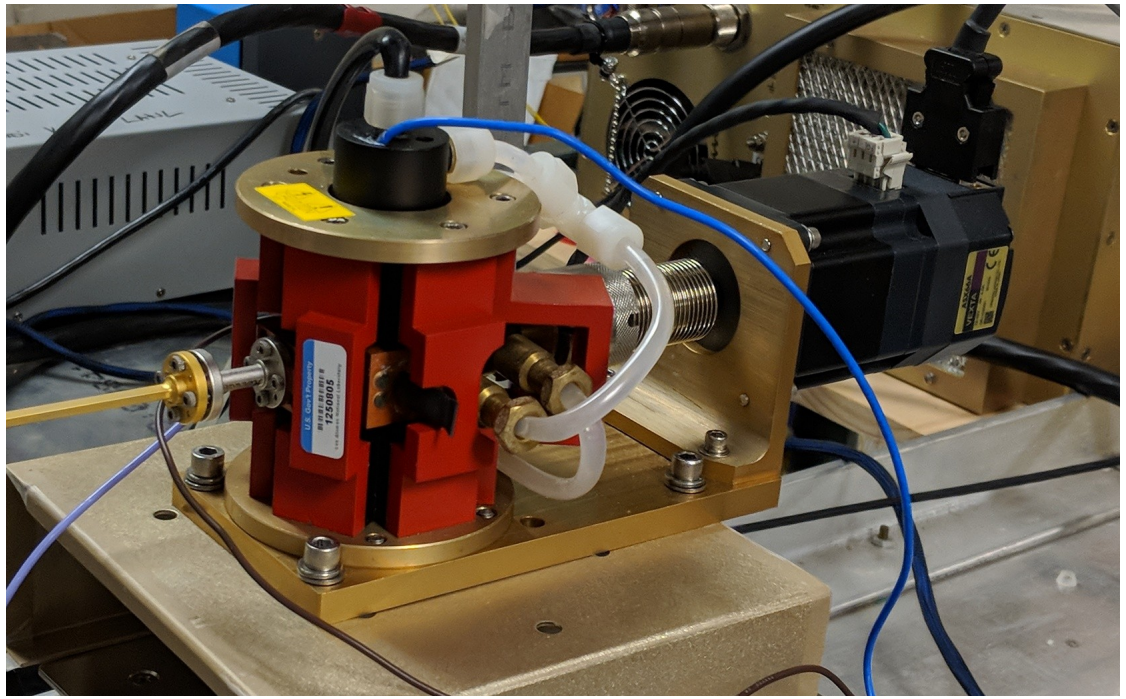
Microwave controls testing

Linear Motor Test

- No issues found with motor logging.
- Motor position tracking working; compares nicely to annual readout.
- Currently not connected to motor control automated mode – this will take a bit of work to add.
- Add direct read-back from frequency monitor and use to auto calibrate motor position map file.



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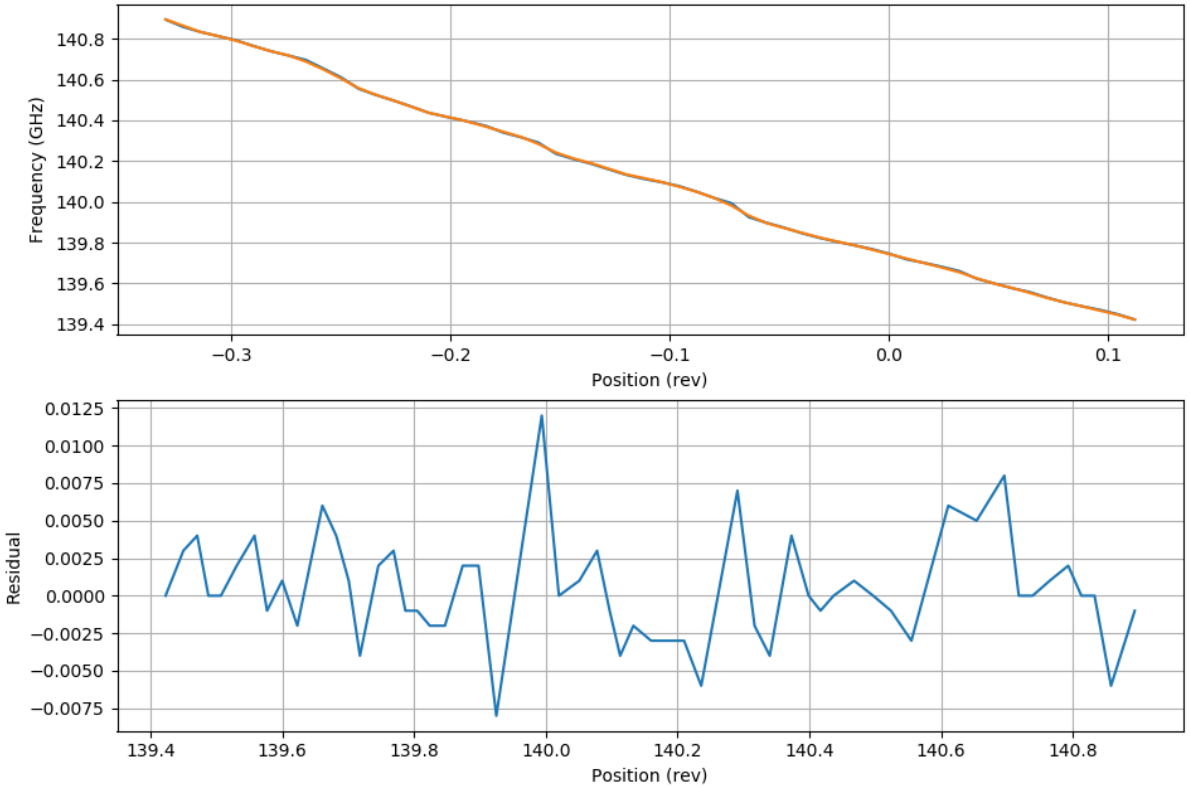

NMR Comparison

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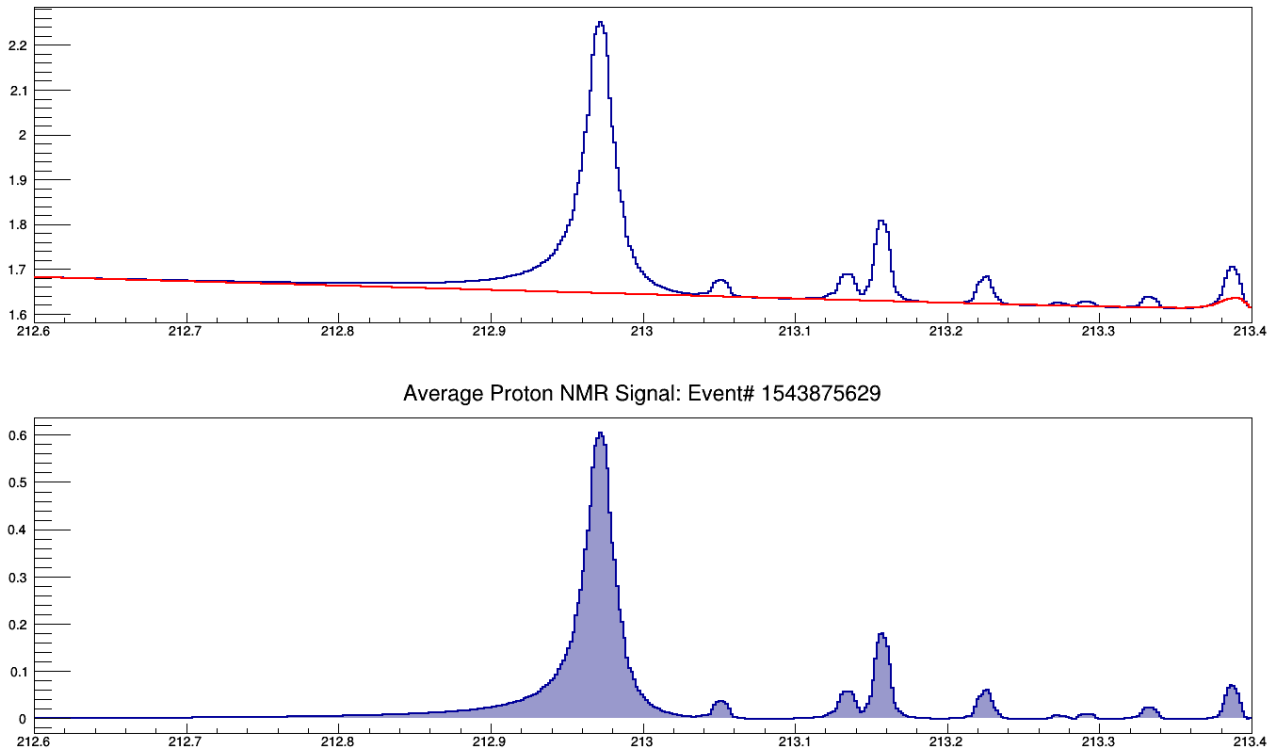
- A large amount of data taken by Misha – analysis in progress
- At first glance the ratios track together so it is encouraging.
- Background subtraction done using background algorithm in ROOT since background measurements can't be taken with crystal.
- A more exhaustive analysis requires data quality checks, a careful background subtraction, working out a sensible automation algorithm, and errors on data points.



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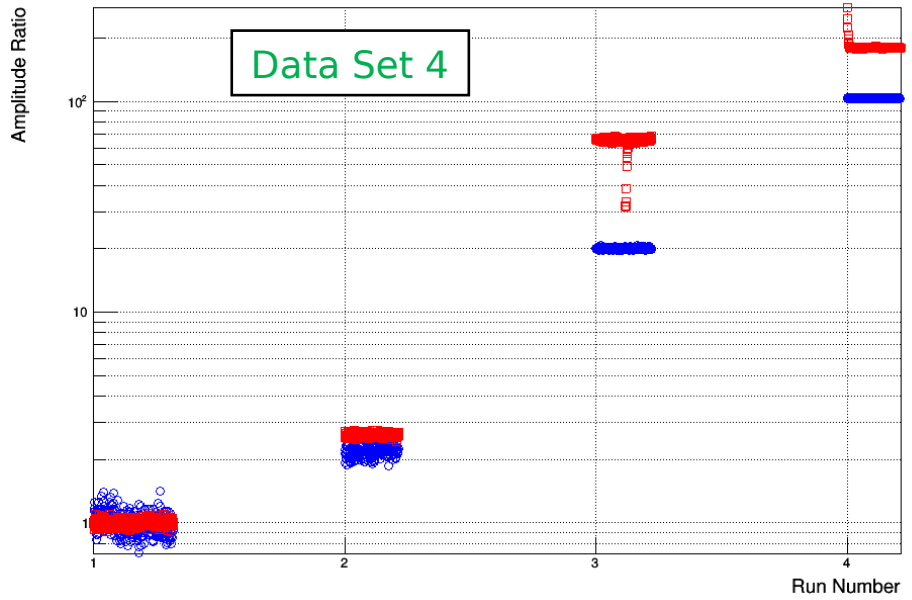
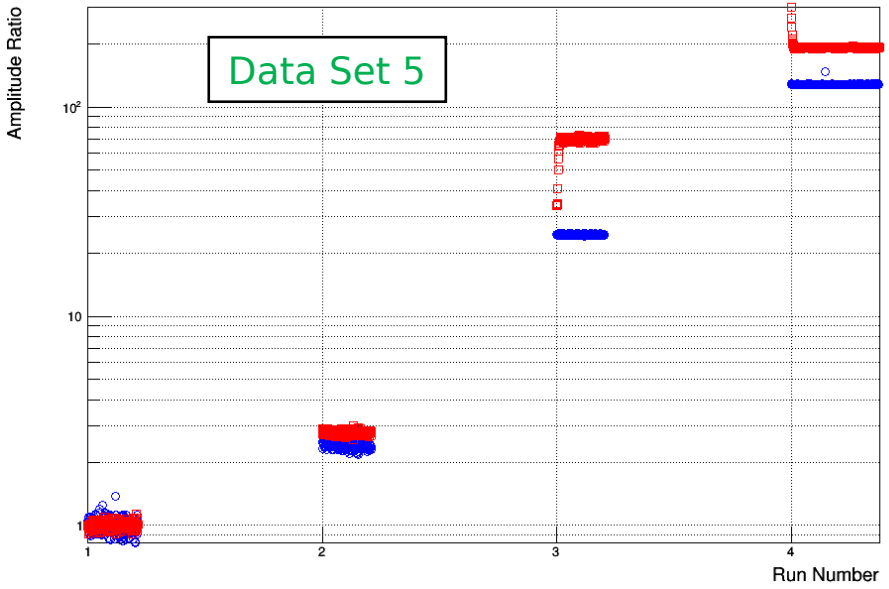




Valve testing and automation

The fridge has two valves that control liquid He from the separator; the run valve and the bypass valve.

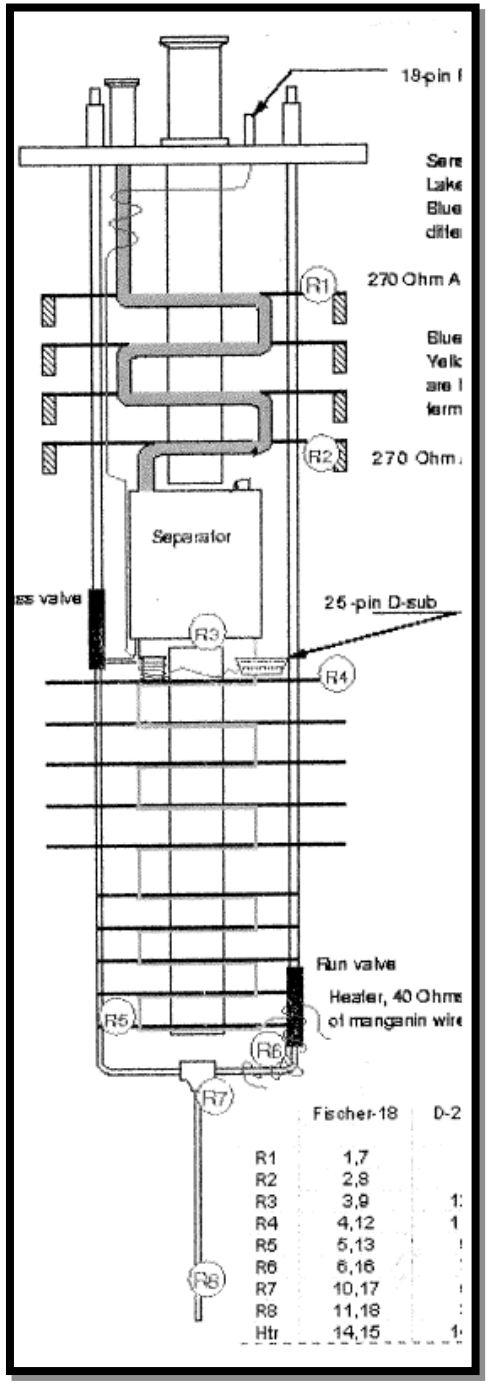
Valves were replaced recently → need to test to be sure they are not leaking significantly.

Valves can also be operated manually or remotely via rotational stepper motors.

General Procedure

- Fridge back-filled with atmosphere and 1 atm warm He gas.
- Pumped down separator till leak rate stable.
- Opened one turn, then close.
- Time how long the leak rate take to return to initial leak-rate.
- Valves were operated by hand (baseline), then using Labview controls.

  Allows us to characterize how well the automatic controls work, ie. does it the valve close as well and does the clutch need to be adjusted.



Fridge back-filled with atmosphere

Run Valve	Baseline Leak Rate ((nbar x L)/S)	Time back to baseline
Manual Operation	157	1:14
Stepper Motor Operation	165	1:10

Bypass Valve	Baseline Leak Rate ((nbar x L)/S)	Time back to baseline
Manual Operation	145	1:09
Stepper Motor Operation	140	0:59

Fridge back-filled with 1 atm. Warm He

Run Valve	Baseline Leak Rate ((nbar x L)/S)	Baseline (10 min elapse)
Manual Operation	275	1200
Stepper Motor Operation	1150	1150

Bypass Valve	Baseline Leak Rate ((nbar x L)/S)	Baseline (10 min elapse)
Manual Operation	1100	700
Stepper Motor Operation	690	690

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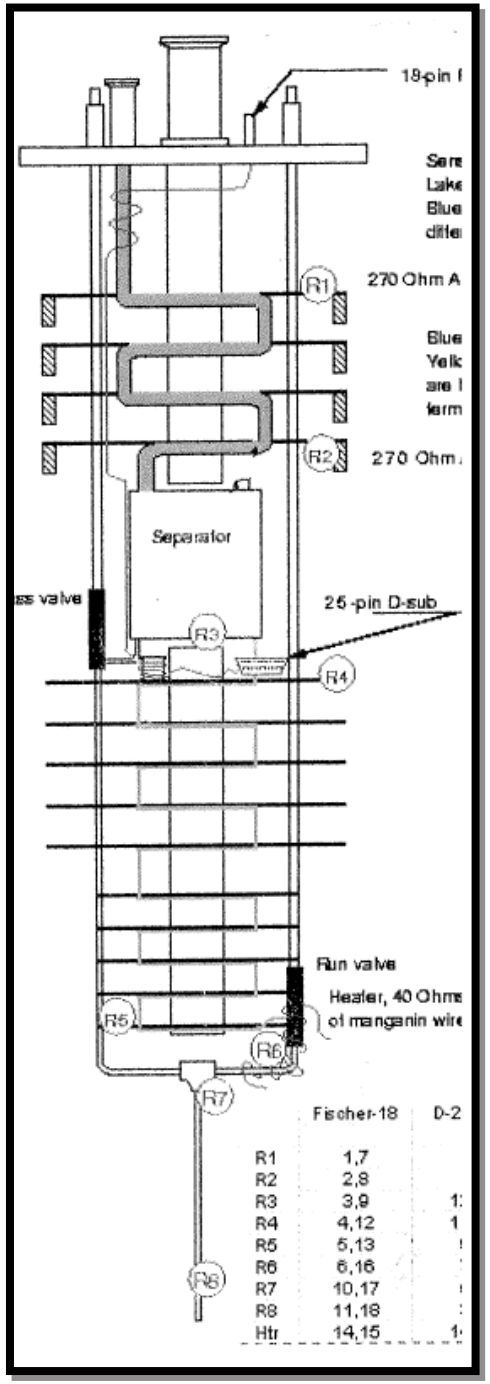
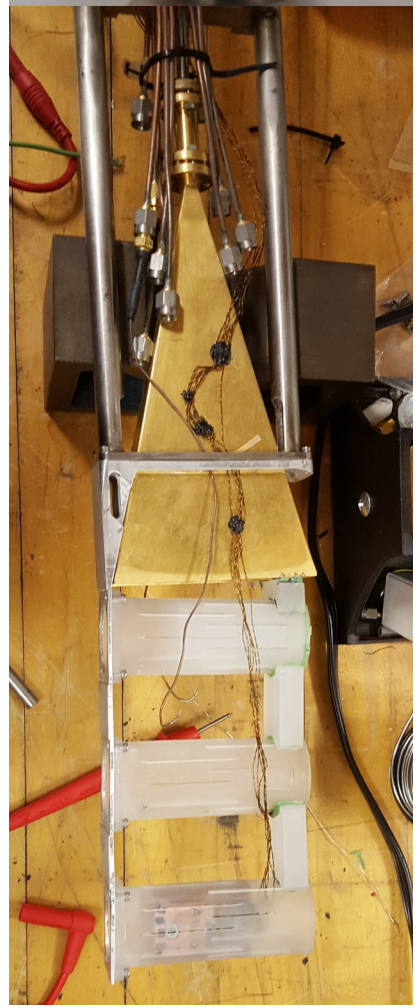
Results and Moving Forward

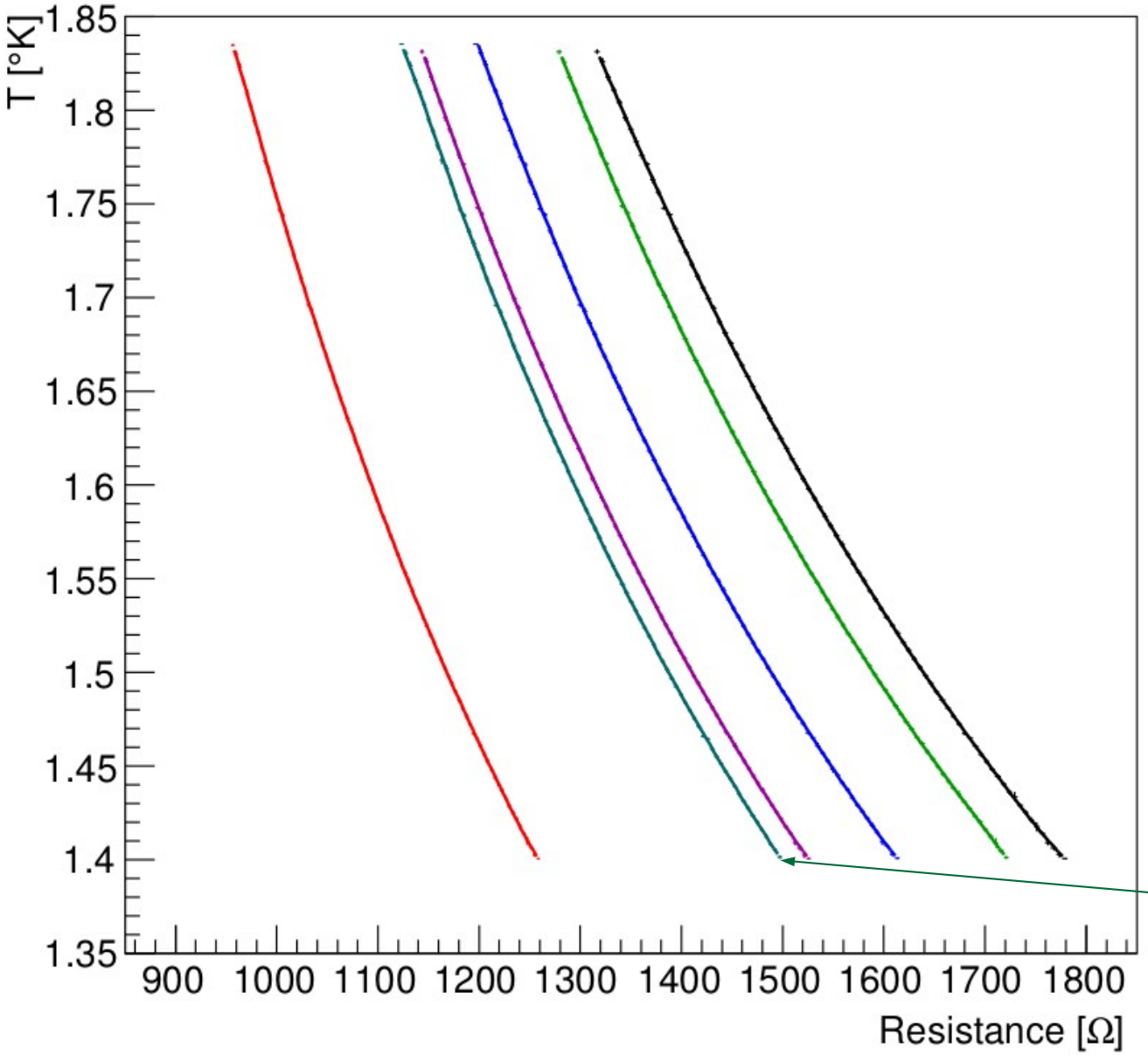
- Valve performed consistently.
- Labview controls were able to control the valves effectively in manual mode. Moving forward a few tweaks are needed for operation in automatic (PID) mode.
- As a whole the tests were a success.

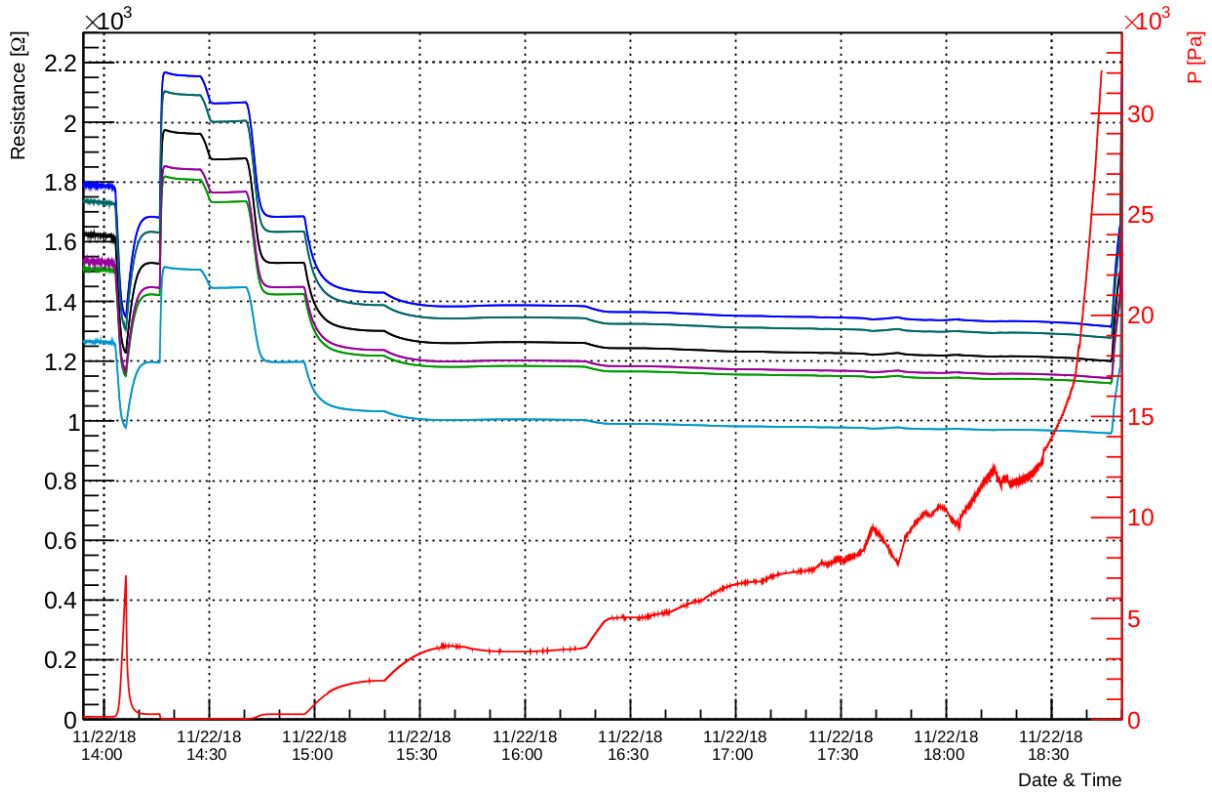


Cernox Temperature Calibration

- Lake Shore Cernox sensors will provide read-back temperature on target insert near target cups.
- High sensitivity temperature read-back starting at 100 mK.
- Lake Shore provides on calibrated reference sensor that we can use to calibrate the rest.
- Each sensor was attached to a machined copper insert that was placed in one of the target insert cups.
- Resistance read-backs of each sensor were monitored along with the He vapor pressure; the Lake Shore calibration only went to 1.4 K so the vapor pressure measurements give us a way to calibrate to a lower temperature as well as providing redundancy.







Reference sensor

Cool-down Team

UVA

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Liliet Calero Díaz

LANL

Mikhail Yurov

NMSU

Forhad Hossain

NHU

David Ruth

End